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(19)(CA) **APPLICATION FOR CANADIAN PATENT** (12)

(54) Process for Deoiling Wastes

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ABSTRACT OF THE DISCLOSURE

2031857

A process for deoiling wastes is disclosed. The process is integrated with a refinery and utilizes one or more refinery intermediary hydrocarbon streams as a solvent to recover waste oil for reprocessing in the refinery and to produce clean waste solids for disposal.

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This invention relates to a process for deoiling wastes. In particular, a process is disclosed comprising the treatment of an oily sludge or soil to produce clean solids and to recover waste oil capable of being reprocessed in a refinery.

BACKGROUND OF THE INVENTION

Petroleum refineries have need to dispose of wastes comprised of oily sludges (oil-solid or oil-solid-water mixtures) produced in wastewater treatment facilities and hydrocarbon storage tanks. Land-treatment (landfarming) has been a low cost disposal method for such wastes. However, in some jurisdictions, landfarming is coming under stricter control and is now subject to more extensive permit requirements. Moreover, certain types of oily sludges cannot be landtreated due to the biorefractory nature of the oil contained therein. For example, some refinery tank bottom sludges (e.g., coker hot slop tank sludge and cat fractionator bottoms sludge) contain viscous oil and high levels of biorefractory polynuclear aromatic components, which are not suitable for disposal through landtreatment.

Removing the oil from an oily sludge and then, instead of landtreating, simply landfilling the remaining solids in a unsecured landfill could be an attractive waste management option, provided that deoiling of the sludge can be done cost effectively to produce an essentially oil-free solids product. Conventional deoiling processes and services are costly and in some cases do not achieve complete oil removal. Extraction-based technologies, using light

hydrocarbons (C_3-C_5) or special solvents, rely on recovery and recycle of their solvent, and may leave asphaltene fractions of the oil on the solids.

It is therefore an object of the present invention to provide a flexible low cost process for deoiling waste sludges. It is a further object to be able to handle oily sludges containing biorefractory wastes. It is a still further object of the invention to remove the oil from oily sludges without requiring deasphalting of the waste oil or solvent separation and recycle. It is a still further object of the invention to be able to deoil a sludge at a low pressure and temperature.

Various processes for treating oily sludges are disclosed in the prior art. U.S. Patent No. 3,696,021 to Cole et al. discloses mixing an oily sludge with light hydrocarbons passing through a conduit. Solids, water and oil are separated in a drum. The oil is heated in a vessel and distilled in a tower to separate heavy oil and recirculate the light oil. The solids are used for landfill.

U.S. Patent No. 4,014,780 to McCoy mixes an oily sludge with a diluent recycle oil and heats the mixture with steam to recover the oil and form dry solids for a landfill. U.S. Patent No. 4,097,378 to St. Clair discloses mixing sludge with oil and then treating the same with recycle oil. U.S. Patent No. 4,264,453 to Mraovich discloses filtering coke from oil wastes mixed with a diluent oil. U.S. Patent Nos. 4,686,048 and 4,741,840 to Atherton et al. prepares sludge fines for a landfill by mixing the sludge with a hydrocarbon diluent.

U.S. Patent No. 4,264,453 addresses the treatment of coal tar wastes and uses a non-aromatic diluent with surfactants to render the wastes (coke fines, viscous oil, water) amenable to separation by filtration. U.S. Patent No. 3,696,021 uses butane, pentane or their mixture as a solvent and requires a high temperature (300-400°F) and a high pressure (500-600 psig) separation of solvent from waste oil. U.S. Patent No. 4,686,048 uses a hydrocarbon type solvent having a boiling point when mixed with water of less than 212°F. In addition, it requires mixing of filtered cake with 100% to 1500% water, and distilling the mixture to remove the residual solvent from the solids.

Various patents disclose combining a waste sludge with a refinery stream. U.S Patent No. 4,206,001 discloses a process for separating solid and liquid materials in an FCC rundown tank to permit liquids to be returned to refinery process streams. The process comprises the addition of a selected refinery stock, preferably kerosene-like, into the rundown tank, followed by washing of solids with an aqueous solution, and subsequent settling to separate the aqueous and organic phases. U.S Patent No. 2,487,103 teaches adding a heavy naphtha fraction to sludge, followed by addition of water for hydrolysis and phase separation. U.S Patent No. 3,696,021 discloses mixing refinery sludges with light hydrocarbons to deoil the solids, followed by gravitational separation and steaming of the separated solids to remove the light hydrocarbons Other patents in this area include U.S. Patent No. 2,413,310; U.S. Patent No. 3,079,326; U.S. Patent No. 1,092,386; and U.S. Patent No. 1,092,386.

BRIEF DESCRIPTION OF THE INVENTION

The present invention is directed to a process for the deoiling of oily sludges so that the remaining solids can be disposed of economically, for example, in landfills. According to the invention, the sludge is treated with one or more solvents obtained from a refinery unit. In one preferred embodiment, the sludge is first treated with a heavy aromatic stream, for example from a cracking unit. The residual solids are then treated with a light solvent such as naphtha, followed by low energy evaporation of the solvent by evaporation or gas stripping. In another preferred embodiment, a single solvent is employed to extract and deoil the sludge, which is then separated into liquid and solid phases. The liquid phase is returned to the refinery for reprocessing and the solid phase is dried to remove remaining liquids. The resulting clean and essentially oil free solids is then suitable for low cost disposal.

BRIEF DESCRIPTION OF THE DRAWINGS

The process of the invention will be more clearly understood upon reference to the detailed discussion below in conjunction with to the drawings wherein:

FIG. 1 shows a simplified process flow diagram illustrating one embodiment for practicing the subject invention wherein two separate solvent extractions of an oily sludge produces a clean solids product for low cost disposal; and

FIG. 2 shows a simplified process flow diagram illustrating a second embodiment of the present invention wherein a single solvent is employed to extract a waste oily sludge and wherein a solids residue is dried to produce a clean solids product for landfill.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is directed to a process for deoiling an oily sludge produced in a refinery, comprising (a) in an extraction zone, mixing the sludge with a solvent comprising a distillate stream from a refinery unit, whereby oil components of the sludge are extracted into the solvent; (b) in a separation zone, separating the mixture formed in the extraction zone into at least two streams, a first stream comprising said solvent with extracted oil, and a second stream comprising substantially all of the solids in said sludge, whereby said solids are depleted of its oily content; and (c) in a stripping zone, drying the solids with a stripping gas to produce a relatively dry solids containing material which can be readily disposed of, for example, by means of a landfill.

In one preferred embodiment, an oily sludge produced in a refinery is treated according to a process involving the use of two different solvents. This embodiment comprises (a) in a first extraction zone, mixing the sludge with a relatively heavy solvent comprising an aromatic distillate stream from a refinery unit, whereby oily components of the sludge are extracted into the solvent; (b) in a separation zone, separating the mixture formed in the first extraction zone into at least two streams, a first

stream comprising said relatively heavy solvent (including extracted oil) and a second stream comprising substantially all of the solids in said sludge, whereby said sludge is depleted of its oily content; (c) recycling at least a portion of said first stream to said refinery for reprocessing in a refinery unit; (d) in a second extraction zone, mixing said sludge residue with a relatively light solvent comprising a hydrocarbon distillate from a refinery unit, whereby remaining relatively heavy solvent is displaced; and (e) in a stripping zone, drying the mixture formed in the second extraction zone with a stripping gas to produce a clean relatively dry solids containing material suitable for landfilling.

This latter embodiment, comprising a two-step oil displacement process involving two different kinds of solvent streams, ensures maximum removal of heavy molecular weight oil in the waste (due to a first-stage treatment by a high aromatic, heavy solvent) and produces essentially oil-free solids (due to a second-stage treatment by a light solvent). The process advantageously does not require recovery of solvents from a oil-solvent mixture. Rather the latter mixture is recycled to the refinery for reprocessing.

In this description, the terms "waste" and "wastes" refer to oil-contaminated material, including oily sludge and oily soil. When referring to an oily sludge, it will be apparent to those skilled in the art that the same applies to an oily soil, for example.

In general, the invention herein described is a refinery integrated process employing an

intermediary hydrocarbon stream as a solvent to extract oil from wastes, and utilizing the refinery for reprocessing of the resulting oil-solvent mixture. The processing steps can be carried out in a batch, continuous, or semi-continuous mode using single or multiple vessels built as a mobile or stationary unit.

The scope and extent of treatment of an oily sludge according to the present process may depend on the properties of the sludge and its oil (e.g., the amount of heavy hydrocarbons such as asphaltenes), the desired quality specification of the solid product, and the ultimate disposal method for the solids.

The process of this invention can be used with both dry and wet sludges. However, the water content of the sludge should be low enough (preferably less than 50%) to permit an effective contact between the oily solids and solvent. A sludge containing greater than 50% water can be dewatered separately by pretreatment or dewatered during the separation (e.g. centrifuge) step of the process.

Where the sludge to be treated contains significant amounts of especially asphaltenic and viscous oil, then the aforementioned multi-extraction process, employing two different solvents is preferred. As previously indicated, a first extraction step involves treatment of the sludge with a heavy solvent such as a low value, highly aromatic distillate stream from a thermal or catalytic cracking unit of a refinery to dissolve and displace the sludge-oil without causing deasphalting. A second extraction step involves treatment of the solids or sludge residue from the first extraction step with a light solvent such as a low value naphtha to displace the

heavy solvent (or sludge-oil), and to permit low energy removal of the light solvent from the solids product.

The solvent employed in a first extraction zone suitably comprises at least 20 percent by weight aromatics, preferably 40 to 75 percent aromatics, and has a boiling point of 100 to 600°C, preferably 160 to 400°C. Suitable solvents include light heating oil or heavy naphtha distillate from a cat cracker. The relatively lighter solvent employed in a second extraction zone suitably is a refinery stream boiling in the range of 24 to 300°C, preferably 35 to 175°C. Although an aromatics content of 2 to 5 percent is preferred, a much higher percent of aromatics is suitable when using a toluene or xylene type solvent. Suitable solvents in the second extraction zone include light and/or heavy naphtha such as light natural naphtha (LNN), heavy natural naphtha (HNN), powerformer feed, light cat naphtha (LCN), reformate, heavy cat naphtha (HCN) and splitter overhead (SPOH). Hydrocarbon streams comprising primarily C_5 to C_9 hydrocarbons with at least 2 percent aromatics content are suitable sources of solvents for the second extraction.

In the event that the present invention is practiced with a single extraction zone using single solvent, then this solvent is suitably of the kind mentioned above with respect to the second extraction zone in the multi-extraction zone process.

Extraction according to the present process may be suitably carried out at a sludge to oil weight ratio varying from about 2:1 to 1:5, at atmospheric pressure, and at a temperature below the initial

boiling point of the solvent utilized. Preferably, the oily waste is mixed with a distillate stream in a waste/distillate ratio of 2:1 to 1:2 at 10 to 100°C. Mixing is continued until the liquid phase properties do not change, and/or approach levels expected from a theoretical blend of waste oil and solvent in the same ratio. However, if the sludge contains high concentrations of emulsified water and if the water hinders effective mixing during extraction, then the conditions and solvents can be selected to permit evaporation of water during extraction.

Following extraction, a liquid-solid separation is carried out, preferably by gravity settling, which is continued until the supernatant suspended solids concentration reaches an equilibrium level or a level acceptable for reprocessing of the supernatant. As an option, water can be added during or after gravity settling to displace intra-particle oil (minimize oil remaining in solid phase) and to form a layer between the oil and solid phases to aid in the removal of the supernatant. However, if solid settling characteristics do not permit a reasonably fast separation of solid and liquid, or the solid concentration of the supernatant is higher than reprocessing specifications, then a mechanical separation, for example, filtration or centrifugation, may be employed. Mixing and settling may occur in the same or separate tanks and can be carried out in the original product storage tanks containing the waste or in temporary tanks. The liquid supernatant from the solid-liquid separation is returned to the refinery slop system and from there to an appropriate refinery unit (e.g., tanks, distillation, FCC, etc.) or blended into crude for reprocessing.

Following extraction and solid-liquid separation, the solids are subjected to a drying step, comprising the removal of final (light) solvent. This is suitably accomplished either by stripping (nitrogen, steam, etc.) or by evaporation at a temperature consistent with the boiling point of the solvent.

The above-described procedure can be carried out in multiple stages, the number depending on specific application and performance requirements. When utilizing a single solvent, then at least 3 and preferably 4 to 6 separate extraction stages are carried out to achieve the desired solids product specifications. Each stage comprises a solvent-sludge mixing/extraction step, and a solids-liquid separation, followed by a recycle of the solids phase to the mixing/extraction zone if separate tanks for the mixing/extract and solids/liquid separation are used and a further extraction stage is required.

FIG. 1 shows a first embodiment of the present process which employs two different solvents to produce clean solids for low cost disposal. Referring to FIG. 1, an oily sludge feedstream 1 is admixed with a relatively heavy solvent stream 3 comprising an aromatic refinery distillate. Optionally, if the water content of the sludge is relatively high, it is possible to subject the sludge to a preliminary gross dewatering in zone 5, for example by mechanical filter press or centrifuging, as is well know to those skilled in the art. (The broken lines in the figure indicate optional steps.) The sludge and solvent mixture is introduced into a first extraction zone 7 wherein the oily components of the sludge are solubilized in the solvent. It is to dewater the mixture optional at this stage, instead of preliminary

to extraction, by removing a water phase. The extraction zone effluent is thereafter introduced into a first separation zone 11, wherein solids are separated from liquids. As mentioned above, this separation can be accomplished in various ways as will be understood by those skilled in the art, although the presently preferred low cost method is by means of gravity settling. Water to aid in liquid-solid separation is optionally introduced into the mixture at this stage. The heavy solvent, containing the oil extracted from the sludge, is then removed via stream 13 and sent back to the refinery for reprocessing. Optionally, a water phase may be formed at this stage and removed via stream 15. The separated wet solids from the first separation zone 11 is then sent via line 14 to a second stage extraction comprising light solvent treatment, wherein the wet solids are mixed with a light solvent stream 17, for example comprising naphtha or any C_5 to C_7 refinery unit overhead stream. The solvent-solids mixture is thereafter introduced into a second extraction zone 19, wherein the solids are further deoiled by extraction of remaining oily components into the light solvent and any residual heavy solvent is displaced. The solvent-extract-solids mixture in stream 21 is then introduced into a second separation zone 23 wherein the following streams are produced: a solvent stream 25, an optional water stream 27, and a wet solids stream 29. Water is optionally introduced into the second separation zone. The separated solvent stream 25 comprises the light solvent and any heavy solvent remaining in the wet solids. The wet solids in stream 29 at this point are subjected to strip drying in zone 33 to produce an essentially dry solids stream 35 for reuse or disposal, for example, in a clean landfill or backfill.

The light solvent in stream 37 is sent for reprocessing in the refinery.

FIG. 2 shows a preferred embodiment of the present process utilizing a single solvent. Referring to FIG. 2, an oily sludge in stream 39 containing preferably less than 50% water is provided, for example, by a feed hopper (not shown) for complete admixture with a solvent stream 44 in a mixer/extractor 45. The sludge in stream 39 and the solvent in stream 44 are admixed in a 2:1 to 1:1 ratio by weight of sludge to solvent. A feed hopper can be operated in a semi-continuous mode, wherein the oily sludge is fed for a set period of time to fill the mixer/extractor 45 and the lines connected thereto. The hopper is then is shut off. On the other hand, the solvent is preferably delivered continuously to the mixer/extractor 45, suitably a ribbon-type device having a holdup of 3 to 5 minutes. The mixing energy needed in the mixer/extractor 45 depends on the type of sludge being processed, e.g. a heavy tank bottoms (oil-solids) may require high shear mixing, whereas a wet oil sludge may require only gentle agitation. The mixer/extractor 45 performs the function of extraction, wherein the solvent extracts oily matter from the sludge. The well mixed slurry from mixer/extractor 45 is continuously discharged via line 47 to a separator 49 such as a centrifuge. Optionally, water is introduced into the separator 49 to displace intra-particle oil, minimize oil remaining in the solids-containing phase, and to form a layer between the oil-containing phase and the solids-containing phase to aid in the removal of the supernatant liquid. The separator 49 produces a solids cake which is recycled back to the mixer/extractor 45 through line 51 by means of an appropriate transporting device such

as a conveyor belt or auger (not shown). The separated liquid stream 69 from the separator 49 enters a vessel or drum 71 wherein further settling produces two phases, an upper so-called slop stream 73 and a lower water phase 75. The latter can be sent to waste water treatment, and the slop stream 73 can be sent to the refinery for reprocessing.

The solids recycle in line 51 is continued until the solids have achieved the desired residual oil quality, usually the equivalent of about 3-6 stages of extraction. When extraction is completed, recycle of solids to the mixer/extractor 45 is stopped and the solids emptied out before the feed hopper is restarted. The solids are then diverted, for example via a second auger (not shown) through a valve 53 to a drier 55. The solids are batch dried at 90 to 150°F with steam purge in line 57 to remove residual solvent. The sweep gas in line 59 is passed through a condenser 61 to recover the solvent. The solvent is either sent to the refinery for reprocessing or recycled via stream 63 to vessel or drum 65, wherein make-up solvent stream 67 may be introduced. Gas is vented, if necessary, through an emission control system (e.g., charcoal traps) via line 66.

The solids from the drier 55 are discharged and may be sent in line 58 to a landfill or other means of disposal. The clean solids product suitably has an oil content below 1 percent, preferably below 0.5 percent and a PAH (polynuclear aromatic hydrocarbon) content below certain ppm limits.

It will be appreciated by those skilled in the art that the process scheme shown in FIG. 2 can also apply with minor modification to a two solvent

extraction process of the kind shown generically in FIG. 1. In such a case, a second solvent drum can be added, with a line leading to the mixer/extractor 45. After the oily sludge is extracted with the first solvent from drum 65 via line 44, then a second solvent can be introduced, by appropriate valve change, into the mixer for a second extraction, before sending the solids to drier 55 through valve 53.

The following examples are given to illustrate the present invention and to indicate its unexpected degree of effectiveness. It is not intended to limit the present invention to the particular method employed, the particular sludge composition, or the specific conditions of operation employed in these examples.

Example 1

A sample of a filter backwash sludge from a refinery water effluent treatment system was treated in the lab according to the present invention. The sludge contained 15.8 wt.% oil, 75.3 wt.% water, and 8.9 wt.% solids. The sludge was first treated with a heavy solvent comprising heating oil from a catalytic cracking unit (LCHO). A gas chromatograph distillation curve of the LCHO is provided in Table 1 below:

Table 1

GC Distillation, °C:	IBP = 161
	10% = 216
	50% = 275
	90% = 386
	FBP = 400

The treatment conditions for a first and second stage extraction are provided in Table 2 below:

Table 2

Treatment Conditions	Stage 1	Stage 2
Sludge Solvent Ratio	1/1 wt/wt	1/2 wt/wt
Extraction Temperature	100°C	22°C (lab temp)
Extraction Pressure	1 atm.	1 atm.
Extraction Time	2 hrs.	20 min.

The dried solids after treatment were essentially free of oil (contained 1.4% methylene chloride extractable oil) and had a look of a natural soil with no hydrocarbon odor.

Between the two extractions, the material was allowed to settle by gravity overnight and the supernatant decanted off. The supernatant contained 0.09 wt.% solids. The bottom settled material was dried at 60°C and 1 atm. pressure for 30 minutes. An oil analysis of the dried solids (as measured by soxhlet extraction with methylene chloride solvent) showed 1.4 wt.% oil remaining on the solids and the material looked very dry and loose.

Example 2

This example shows application of this invention to a variety of sludges of different water content using a variety of different solvents. The properties of three different types of sludges (API dewatered separator bottoms, tank bottoms, and oily woodchips) are provided in Table 3 below. In Table 4

are given the properties of the various solvents, abbreviated SPOH (splitter overhead), LNN (light natural naphtha), HNN (heavy natural naphtha), LCN (light cat naphtha), and HCN (heavy cat naphtha).

Table 3

Untreated Sludge Properties

	Weight %		
	Oil	Water	Solids
API (dewatered) Separator Bottoms	25	30	45
Tank Bottoms	36	0 <	64
Oily Woodchips	7	47	46

Table 4

Solvent Properties

	SPOH	LNN	HNN	LCN	HCN
GC Distillation, °C					
IBP	24	26	125	21	87
10%	32	47	138	35	162
50%	43	98	150	95	198
90%	63	136	164	170	218
FBP	72	146	176	204	261

The API sludge was pretreated (dewatered) to reduce water content by a centrifuge while the tank bottoms and oily woodchips were deoiled as is. All operations were carried out at ambient temperature and pressure. A 100 g portion of sludge was mixed with 75

g of solvent by hand (gentle agitation) for 3 minutes. The slurry was separated using a lab centrifuge. The solids from the centrifuge were taken and remixed by hand with 75 g of fresh solvent. The mixing and separation was repeated until the solids had been extracted 4 times, at which time they were dried at 137°C for 2 hours. The dried solids were then analyzed for residual oil and grease and the results shown are in Table 5.

Table 5

Final Oil on De-Oiled Solids, wt%

Chips	Tank Bottoms	API Separator	Oily Wood
SPOH	0.6	0.3	0.5
LNN	0.2	0.4	0.6
HNN	0.2	--	--
LCN	0.2	--	--
HCN	0.6	0.5	0.5

In conclusion, the process simulated in the lab resulted in solids with not more than 0.6% oil and grease and therefore essentially clean.

Example 3

This example demonstrates that the present process produces clean solids meeting quality specifications in terms of trace organics and metals. The sludge treated was API separator bottoms with an oil/water/sludge weight ratio of 25/30/45. The treatment conditions were the same as in Example 2, using heavy cat naphtha (HCN) as the solvent, except

that the wet solids were dried at 100°C under nitrogen purge. The solids product was measured for gross parameter oil, polynuclear aromatic hydrocarbons (PAH), and metals content by standard tests. The results are shown in Table 6 below.

Table 6

	Solids After Deoiling
Parameter Oil, wt%	0.5
Volatiles, wppm	
Benzene	<0.05
Toluene	<0.05
Xylenes	0.19
Ethylbenzene	<0.05
PAH, ppm	
Anthracene	<2
Benzo (a) Anthracene	<2
Benzo (b) Fluoranthene	<2
Benzo (a) Pyrene	<2
Chrysene	<2
Naphthalene	7.3
Phenanthiene	5.7
Pyrene	6.8
Leachate, mg/L	
Silver	<0.05
Arsenic	<0.2
Barium	0.6
Boron	<2
Cadmium	<0.01
Chromium	<0.05
Lead	<0.2

The residual trace organic and leachate criteria for the deoiled solids product is suitable for clean landfill under British Columbia, Alberta and Ontario regulations in accordance with regulatory limits.

The process of the invention has been described generally and by way of example with

reference to particular embodiments for purposes of clarity and illustration only. It will be apparent to those skilled in the art from the foregoing that various modifications of the process and materials disclosed herein can be made without departure from the spirit and scope of the invention.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A process for deoiling an oily sludge produced in a refinery and containing less than 50% water, comprising:

(a) in an extraction zone, mixing the sludge in a ratio of 2:1 to 1:5 at 10°C to 100°C with a solvent comprising a distillate stream from a refinery unit, whereby oily contaminants in the sludge are extracted into the solvent;

(b) in a separation zone, separating the mixture formed in the extraction zone into at least two streams, a first stream comprising said solvent with extracted oily contaminants, and a second stream comprising substantially all of the solids in said sludge;

(c) repeating steps (a) and (b) if further reduction in the oil content of the sludge is desired;

(d) introducing the second stream solids from the separation zone into a stripping zone without the intermediate addition of liquid water;

(e) in the stripping zone, drying the solids with a stripping gas to produce a relatively dry solids containing material having an oily content of less than 2 wt.% which material is then disposed of in an environmentally acceptable manner; and

(f) recycling at least a portion of the first stream produced in step (b) to the refinery for processing in a process unit.

2. A process for deoiling an oily sludge produced in a refinery, comprising:

(a) in a first extraction zone, mixing the sludge with a heavy solvent comprising an aromatic distillate stream from a refinery unit, which distillate stream contains at least 20 wt.% aromatics and has a boiling point of 100°C to 600°C, whereby oily contaminants in the sludge are extracted into the solvent;

(b) in a separation zone, separating the mixture formed in the first extraction zone into at least two streams, a first stream comprising said heavy solvent with extracted oily contaminants, and a second stream comprising substantially all of the solids in said sludge, whereby said sludge is depleted of its oily content;

(c) in a second extraction zone, mixing said second stream with a solvent which is relatively light with respect to said heavy solvent, said solvent comprising a hydrocarbon distillate from a refinery unit and boiling in the range of 24°C to 300°C, whereby remaining heavy solvent is displaced by said hydrocarbon distillate;

(d) in a second separation zone, separating the solids from the distillate solvents; and

(e) in a stripping zone, drying the solids from the second extraction zone with a stripping gas

to produce a relatively dry solids containing material which can be disposed of in an environmentally acceptable manner.

3. The process of claim 2, wherein the heavy solvent contains 40 to 75 wt.% aromatics, a boiling point in the range of 160°C to 400°C, and is a distillate stream from a thermal or catalytic cracking unit of a refinery.

4. The process of claim 2, wherein the relatively light solvent is a low value naphtha boiling in the range of 35°C to 175°C.

5. The process of claim 4, wherein said relatively light solvent comprises mostly a C_5 to C_9 hydrocarbon stream.

6. The process of claim 2, wherein the material of step (e) is landfilled.

7. The process claim 1, wherein said sludge being treated is a tank bottom sludge.

8. The process of claim 2, wherein preliminary to the first extraction zone, the sludge is dewatered to produce a water content ranging from 0 to 50 wt.%.

9. The process of claim 2, wherein the sludge entering the first extraction zone comprises less than 50 percent by weight water.

10. The process of claim 1, wherein the sludge to solvent ratio in the first extraction zone is about 2:1 to 1:2.

11. The process of claim 1, wherein the solids containing stream produced in step (b) is totally recycled back to the first extraction zone for further treatment.

12. The process of claim 1, wherein said stripping gas is steam or nitrogen.

13. The process of claim 2, wherein the gaseous effluent from the drying zone is condensed and the solvent recycled to the second extraction zone.

14. The process of claim 1, wherein steps (a) and (b) are repeated three to six times.

15. The process of claim 1, wherein steps (a) and (b) are repeated until said dry solids meet residual organic targets.

16. A process for deoiling an oily sludge produced in a refinery, comprising the following steps:

(a) in a first extraction zone, mixing the sludge with a relatively heavy solvent comprising an aromatic distillate stream from a refinery unit, whereby oily components of the sludge are extracted into the solvent;

(b) in a separation zone, separating the mixture formed in the first extraction zone into at least two streams, a first stream comprising said relatively heavy solvent including extracted oily components and a second stream comprising substantially all of the solids in said sludge, whereby said sludge is depleted of its oily content;

(c) recycling at least a portion of said first stream to said refinery for reprocessing in a refinery unit;

(d) in a second extraction zone, mixing said sludge residue with a relatively light solvent comprising a hydrocarbon distillate from a refinery unit, whereby remaining relatively heavy solvent is displaced;

(e) in a stripping zone, drying the mixture formed in the second extraction zone with a stripping gas to produce a relatively dry solids containing material; and

(f) landfilling at least a portion of said material produced in step (e).

17. The process of claim 1 wherein at least a portion of the first stream produced in step (b) is blended into crude oil for reprocessing.

18. The process of claim 1, wherein preliminary to the first extraction zone, the sludge is dewatered.

19. The process of claim 1, wherein the gaseous effluent from the drying zone is condensed and the solvent recycled to the extraction zone.

20. The process of claim 2, wherein said sludge being treated is a tank bottom sludge.

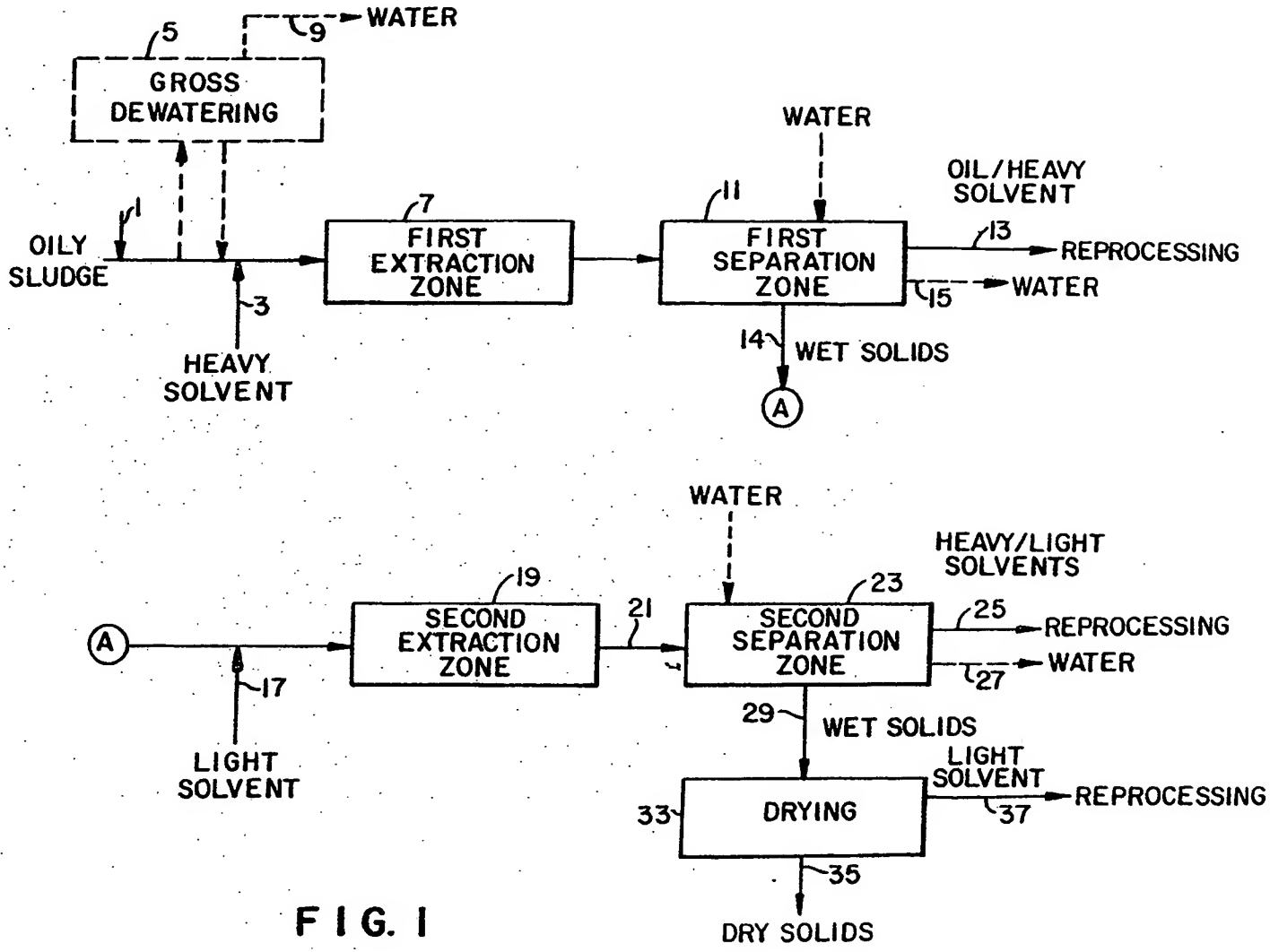

FIG. 1

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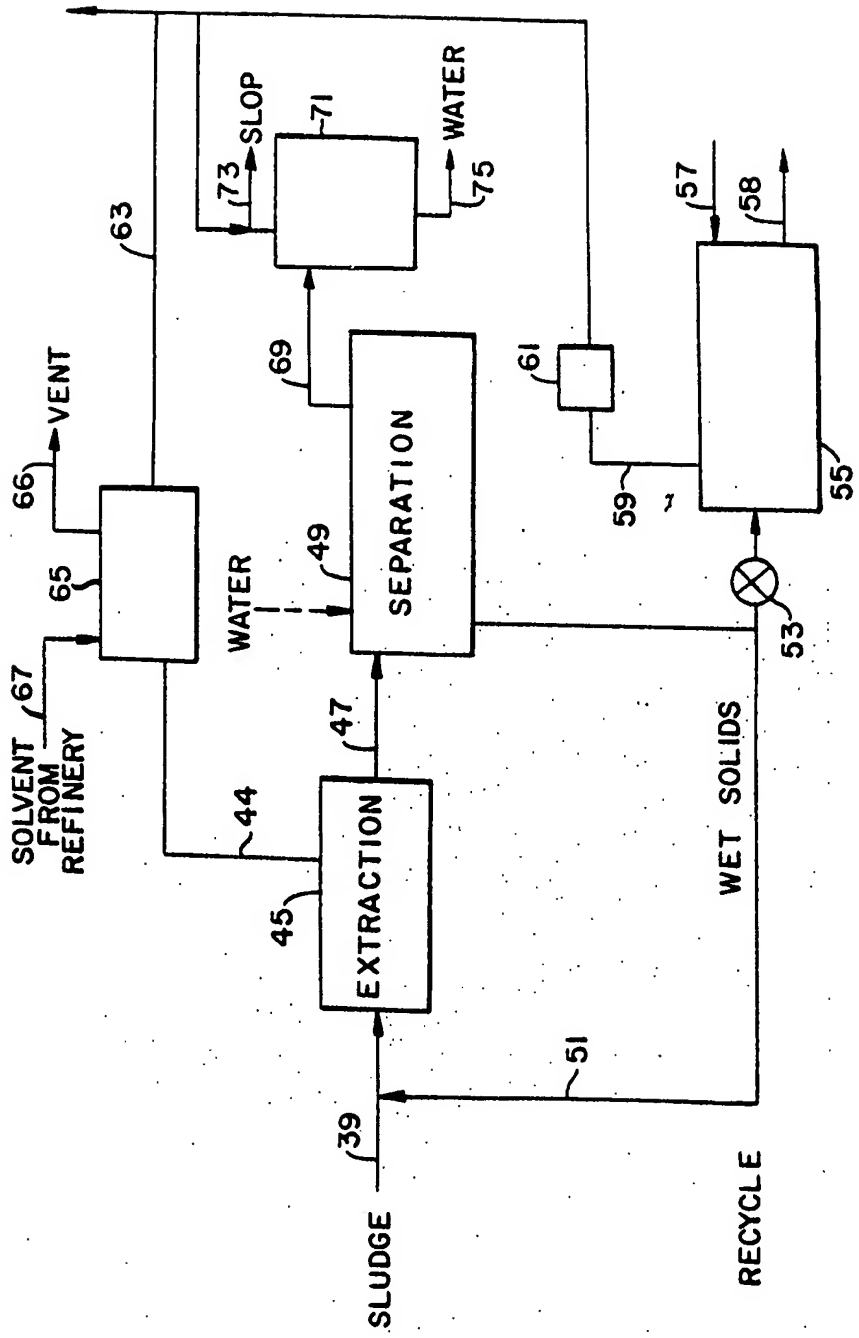

FIG. 2

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